

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

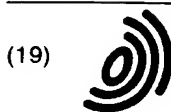
Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 0 795 772 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention  
of the grant of the patent:  
**27.11.2002 Bulletin 2002/48**

(51) Int Cl.7: **G02F 1/13, H01L 21/60,  
H01L 23/498**

(21) Application number: **97301728.8**

(22) Date of filing: **14.03.1997**

(54) **Drive circuit connection structure and display apparatus including the connection structure**

Kontaktierungsstruktur für Treiberschaltung und Anzeigevorrichtung mit dieser  
Kontaktierungsstruktur

Structure de connexion de circuit de commande et dispositif d'affichage comportant cette structure

(84) Designated Contracting States:  
**DE FR GB IT NL**

(30) Priority: **15.03.1996 JP 5966596**

(43) Date of publication of application:  
**17.09.1997 Bulletin 1997/38**

(73) Proprietor: **CANON KABUSHIKI KAISHA**  
**Tokyo (JP)**

(72) Inventors:  
• **Takahashi, Masanori**  
**Ohta-ku, Tokyo (JP)**  
• **Saito, Riichi**  
**Ohta-ku, Tokyo (JP)**  
• **Ouchi, Toshimichi**  
**Ohta-ku, Tokyo (JP)**

(74) Representative:  
**Beresford, Keith Denis Lewis et al**  
**BERESFORD & Co.**  
**2-5 Warwick Court,**  
**High Holborn**  
**London WC1R 5DH (GB)**

(56) References cited:  
• **PATENT ABSTRACTS OF JAPAN vol. 096, no.**  
**004, 30 April 1996 & JP 07 321152 A (CITIZEN**  
**WATCH CO LTD), 8 December 1995,**  
• **PATENT ABSTRACTS OF JAPAN vol. 018, no.**  
**612 (P-1829), 21 November 1994 & JP 06 230405**  
**A (NEC CORP), 19 August 1994,**  
• **PATENT ABSTRACTS OF JAPAN vol. 095, no.**  
**002, 31 March 1995 & JP 06 313893 A (KYOCERA**  
**CORP), 8 November 1994,**  
• **PATENT ABSTRACTS OF JAPAN vol. 017, no.**  
**060 (P-1482), 5 February 1993 & JP 04 269722 A**  
**(ROHM CO LTD), 25 September 1992,**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 0 795 772 B1**

1

EP 0 795 772 B1

2

**Description****FIELD OF THE INVENTION AND RELATED ART**

[0001] The present invention relates to a drive circuit connection structure suitable for use in a display apparatus, and particularly a connection structure including a drive semiconductor device connected to a periphery of a transparent substrate of a display panel constituting such a display apparatus and a circuit board connected to the semiconductor device for supplying input signals and a power to the semiconductor device.

[0002] Hitherto, there have been known display apparatus including flat display devices having display electrodes arranged in the form of, e.g., a matrix, such as EL display panels and liquid crystal display panels of the simple matrix-type and the active matrix-type. Such display apparatus have conventionally included a circuit connection structure including a transparent substrate, such as a glass substrate or a plastic substrate, provided with display electrodes arranged in the form of, e.g., a matrix; a flexible tape carrier package (TCP) loaded with a driver IC by the TAB (tape-automated bonding) method; and a print circuit board (PCB, hereinafter sometimes called "PCB board"), connected in this order.

[0003] Figure 12 and Figure 13 (a view showing an A-A' section in Figure 12) illustrate an example of such a drive circuit connection structure for a flat display panel. Referring to these figures, the connection structure includes TCPs 4p and 8p loaded with driver ICs (as drive semiconductor circuits) 5p and 9p and copper foil patterns 32 (as output electrodes), glass substrates 1ap and 1bp for a liquid crystal panel 1 having electrode terminals 12p extended to peripheries thereof, and ACFs (anisotropic conductive films or anisotropic conductive adhesive) 31 for heat-bonding the copper foil patterns 32 on the TCPs with the electrode terminals 12p on the glass substrates. Further, PCB boards 3p for supplying a power and control signals to the driver ICs 5p and 9p are connected with copper foil patterns 17 (as input electrodes) of the TCPs 4p with solder 20p.

[0004] In such a display panel connection structure for a display apparatus as shown in Figures 12 and 13, as the display panel (particularly a liquid crystal panel) is provided with a larger number of display electrodes at a higher density, the connection pitch for connection between the output electrodes of the TCPs and the electrode terminals on the transparent substrates are decreased down to a required pitch of 50  $\mu$ m or smaller. However, according to a method for connecting TCP with a substrate as explained with reference to Figures 12 and 13, a very sophisticated and accurate bonding technique is required for ensuring such a minute connection pitch because of a limitation in size accuracy of TCPs and a deviation due to thermal expansion during connection by heat bonding of TCPs. Therefore, a connection structure as shown in Figure 14 including bonding of driver ICs 5 to a substrate 1bp by a face-down

mode has been proposed or ensuring such a minute connection pitch.

[0005] More specifically, referring to Figure 14, the connection structure includes a connection by the face-down bonding mode of driver ICs 5 with electrode terminals extended to peripheries of a pair of glass substrates 1ap and 1bp of a display panel and with input electrodes (not shown) formed on the glass substrates 1ap and 1bp. The connection structure further includes flat cables 7a, 7b and 7c for supplying a drive power and control signals from an external control circuit.

[0006] However, in case where such a connection structure as shown in Figure 14 is adopted in a display panel of a larger size, particularly a liquid crystal display panel of an enlarged size as desired, in recent years, the substrates 1ap and 1bp retain only narrow non-opposing peripheral areas while the input electrodes are increased in length, so that the input electrodes are caused to have a higher impedance, thus being liable to cause a delay in transmission of drive waveforms to the display or pixel electrodes leading to pixels.

[0007] In order to obviate the difficulty, it may be conceived of lowering the impedance of the input electrodes by forming the electrodes in a larger thickness, but the realisation thereof is difficult in view of the limitations from the production process and size. Further, the increased impedance of the input electrodes is liable to cause a malfunction of data transfer during transmission of image data for a liquid crystal display panel of a higher definition to driver ICs.

[0008] It is acknowledged that JP 7321152 discloses a structure wherein a semiconductor device chip is bonded by bump electrodes at one end, to terminals of a first substrate carrying a mounted electronic device, and by bump electrodes, at its other end, to conductors patterned on a flexible film. Notably the first substrate is recessed at its periphery and the flexible film is fixed in, and extends outwardly from, that recess, with its conductors flush with the terminals of the first substrate. The features of the preamble of claim 1 are known from that document.

**SUMMARY OF THE INVENTION**

[0009] The present invention is intended to solve the above-mentioned problems of the prior art.

[0010] One object of the present invention is to provide a circuit connection structure which is capable of providing a low input electrode impedance while still being compatible with a minute connection pitch.

[0011] Another object of the present invention is to provide a display apparatus including such a circuit connection structure.

[0012] According to the present invention, there is provided a circuit connection structure according to claim 1.

[0013] It is preferred that the first and second electrodes of the semiconductor device are used as output

3

EP 0 795 772 B1

4

electrodes and input electrodes, respectively, of the semiconductor device, so as to receive input data from the circuit board and supply output signals to the first substrate, thereby driving an electronic device including the first substrate.

[0014] The flexible wiring member may comprise a plurality of conductors formed in a pattern on a flexible carrier film.

[0015] Alternatively, the flexible wiring member may be constituted by a plurality of conductor wires each extending from a first end to a second end and not carried on a carrier film.

[0016] The first electrodes on one side of the semiconductor device may be connected to the electrode terminals on the first substrate which may carry pixel electrodes thereon via, e.g., an anisotropic conductive adhesive (ACF), etc., and without via a flexible wiring member according to the TAB method, thereby ensuring a minute connection pitch. On the other hand, the second electrodes on the other side of the semiconductor device are connected via conductors of the flexible wiring member to the electrode terminals of the circuit board. Particularly when the first and second electrodes of the semiconductor device are used as the output and input electrodes, respectively, the semiconductor device can be supplied with electric power and control signals at a low impedance from the circuit board through the flexible wiring member and the second electrodes, and can supply output signals through the first electrodes at a minute arrangement pitch suitable for a high-definition output.

[0017] Particularly, if the circuit connection structure is included in a driver IC connection structure for a display apparatus including the first substrate as a substrate carrying pixel electrodes of a display panel and the circuit board for supplying electric power and control signals to the driver IC, the semiconductor device can be supplied with input data at a low impedance and without malfunction and can supply drive signals to the display panel through the first electrodes arranged at a minute connection pitch suitable for a higher definition display.

[0018] According to other aspects of the invention there are provided a display apparatus and a tape carrier package structure, respectively, each as defined in claims 12 and 16 of the appended claims.

[0019] These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings, wherein like parts are denoted by like reference numerals.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Figure 1 is a plan view of a display apparatus including a drive circuit connection structure according

to a first embodiment of the invention.

[0021] Figure 2 is a partial sectional view taken along a line A-A' in Figure 1.

[0022] Figures 3A - 3C are partial plan views for illustrating steps of bonding a driver IC onto a flexible wiring member in the display apparatus of Figures 1 and 2.

[0023] Figure 4 is a side sectional view of a resultant connection structure including the driver IC and the flexible wiring member connected to each other after the steps of Figures 3A - 3C.

[0024] Figures 5 - 6 and 8 - 10 are partial sectional views of display apparatus including drive circuit connection structures according to second to sixth embodiments, respectively, of the invention.

[0025] Figure 7 is a sectional view of a partial connection structure incorporated in the embodiment of Figure 8.

[0026] Figure 11 is a block diagram of a liquid crystal display apparatus.

[0027] Figure 12 is a plan view of a liquid crystal display apparatus including a drive circuit connection structure.

[0028] Figure 13 is a partial sectional view taken along a line A-A' in Figure 12.

[0029] Figure 14 is a partial sectional view of a liquid crystal display apparatus including another drive circuit connection structure.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] Figure 1 is a plan view of a liquid crystal display apparatus, as an embodiment of display apparatus, including a drive circuit connection structure according to a first embodiment of the present invention, and Figure 2 is a sectional view taken along a line A-A' in Figure 1. In Figures 1 and 2, reference numerals identical to those used in Figures 12 - 13 denote identical or like parts as in Figures 12 - 13.

[0031] Referring to Figures 1 and 2, a liquid crystal display apparatus 1 includes a pair of transparent substrates 1a and 1b of, e.g., glass, a polarizer 2 (which sandwiches the liquid crystal panel 1 together with a polarizer (not shown) on an opposite side), circuit boards 3 and 10 (of, e.g., a multilayered glass epoxy PCB board) for supplying a drive power and control signals to driver ICs 5 and 9, flexible wiring members 4a and 8, flat cables 6 for supplying data signals to the circuit boards 3, and a flat cable 7 for supplying a drive power and control signals from an external control circuit (not shown). Referring to Figure 2, a liquid crystal 11 (which is a ferroelectric liquid crystal in this embodiment but can also be a nematic liquid crystal, etc.) is disposed between the substrates 1a and 1b.

[0032] The substrates 1a and 1b are provided with electrodes for applying a drive voltage to the liquid crystal 1, and at least one thereof is provided with display electrodes or pixel electrodes leading to or defining the

5

EP 0 795 772 B1

6

pixels and supplying display data signals to the respective pixels. The pixel electrodes extend to non-opposing peripheries of the substrates 1a and/or the substrate 1b to form electrode terminals thereat. In this embodiment, both substrates 1a and 1b are provided with pixel electrodes so as to form a simple matrix electrode structure suitable for driving the ferroelectric liquid crystal including, e.g., data electrodes on the substrate 1a and scanning electrodes on the substrate 1b, and the pixel electrodes are extended to non-opposing peripheries of both substrates 1a and 1b to form electrode terminals 12 thereat.

[0033] Each driver IC 5 is connected to electrode terminals 12 formed on the glass substrate 1b and extended to a peripheral side of the glass substrate 1b, and the input electrodes of the driver IC 5 are provided in advance with gold bumps 15 to which first ends of conductors on a flexible wiring member 4a are connected by the TAB method, and second (the other) ends of conductors on the flexible wiring member 4a are connected to electrode terminals of the circuit board 3.

[0034] At the time of assembling the display apparatus, each driver IC 5 is connected to the glass substrate 1b by first positionally aligning projection electrodes 13 (of, e.g., gold bumps formed on the output electrodes) of the device IC 5 with the electrode terminals 12 on the glass substrate 1b and connecting the projection electrodes 13 and the electrode terminals 12 via an anisotropic conductive adhesive 14 under application of heat and pressure. The projection electrodes 13 (of e.g., gold bumps) may be formed at a minute connection of preferably 50  $\mu\text{m}$  or smaller as shown in Figures 3A - 3C described hereinafter.

[0035] By connecting the driver IC 5 provided with the projection electrodes 13 to the electrode terminals 12 of the glass substrate 1b without using a flexible wiring member 4a, it becomes possible to obviate a thermal positional deviation due to heat during the heat-pressure bonding, thus ensuring a prescribed connection pitch.

[0036] On the other hand, the second ends of conductors 17 (patterned copper foil of, e.g., 15 - 35  $\mu\text{m}$  in thickness) on the flexible wiring member 4a which have been connected in advance at their first ends to the input electrodes of the driver IC are connected to connection electrodes (electrode terminals) 19 of the circuit board 3 by heat-pressure bonding via an anisotropic conductive adhesive 18.

[0037] The copper foil electrodes 17 of the flexible wiring member 4a and the anisotropic conductive adhesive 18 respectively have prescribed thicknesses so that the conductors between the driver IC 5 and the circuit board 3 may have a lower impedance.

[0038] By supplying input signals to the driver IC 5 through low-impedance conductors 17 in the above-described manner, it becomes possible to obviate a delay in transmission of drive waveforms and a mal-function during data transmission. Incidentally, the anisotropic

conductive adhesive 14 for connecting the electrode terminals 12 on the glass substrate 1b and the output electrodes of the driver IC 5, and the anisotropic conductive adhesive 18 for connecting the copper foil electrodes 17 on the flexible wiring member 4a and the connection electrodes 19 of the circuit board 3, may respectively be composed by selecting electroconductive particles and an adhesive suitable therefor and need not be identical to each other.

[0039] More specifically, in the above-described embodiment, a commercially available anisotropic conductive film (ACF) may be used as the anisotropic conductive adhesive 18. Generally, however, the anisotropic conductive adhesive 18 may comprise a liquid insulating adhesive of heat-curable type or UV-curable type containing electroconductive particles dispersed therein. Alternatively it is also possible to use such a liquid insulating adhesive together with gold bumps formed on the electrode terminals. Examples of the electroconductive particles may include Ni-plated or Ni-Au-plated resin particles of 2 - 5  $\mu\text{m}$  in diameter for output electrode connection and Ni particles or Au-plated Ni particles of 5 - 10  $\mu\text{m}$  in diameter for input electrode connection.

[0040] In the embodiment shown in Figure 1, the circuit connection structure characteristic to the present invention as described above is applied to peripheral sides of only one substrate 1b of the display panel 1, and at a peripheral side of the other substrate 1a, drivers IC 9 are connected via a TCP with respect to both input side and output side thereof similarly as in the case of Figure 12. However, it is also possible to adopt the circuit connection structure having a sectional structure as shown in Figure 2 for bonding the driver ICs 9 to the substrate 1a similarly as the driver ICs 5 connected to the substrate 1b.

[0041] Then, a flexible wiring member 4a may be connected to a driver IC 5 by the TAB method, for example, in the following manner.

[0042] First of all, as shown in Figure 3A, an aperture 24 is formed in a film carrier 4 of, e.g., polyimide or polyethylene terephthalate of ca. 25 - 125  $\mu\text{m}$  in thickness, and tin-plated copper foil conductors 17 and 17a are formed thereon. Then, gold bumps 15 (Figure 2) formed on input electrodes of the driver IC 5 are positionally aligned with the copper foil patterns 17 and 17a and subjected to inner lead bonding by means of a bonding tool. Instead of the above-mentioned tin plating of, e.g., 0.2 - 0.6  $\mu\text{m}$  in thickness, it is also possible to use 0.2 - 10  $\mu\text{m}$ -thick solder, 0.2 - 0.9  $\mu\text{m}$ -thick gold or 0.2 - 10  $\mu\text{m}$ -thick Ni for coating the copper foil conductors 17 and 17a.

[0043] The copper foil patterns 17a are used as support patterns for fixing the driver IC and connected to dummy gold bumps (not shown) formed on the driver IC 5. However, it is also possible to dispose additional input electrodes there that can be connected to and receive signals from the flexible wiring member 4a.

[0044] Then, as shown in Figure 3B, only the input

7

EP 0 795 772 B1

8

side of the driver IC 4 is sealed with a resinous sealing agent 16. Then, an unnecessary portion of the flexible wiring member 4a is removed by punching to leave a connection structure having a planar structure as shown in Figure 3C and a sectional structure as shown in Figure 4.

[0045] In this instance, the gold bumps (projecting electrodes) 13 on the output electrodes of the driver IC may preferably be flattened by the bonding tool at the time of the inner lead bonding or by pressing with another flattening pressure member so as to provide a uniform projection height, in order to provide a reliable bonding between the electrode terminals 12 and the output electrodes 5 of the driver IC 4 with an anisotropic conductive adhesive 14.

[0046] In a preferred example of circuit connection structure adopted for constituting a liquid crystal apparatus, each driver IC may have ca. 30 - 60 input electrodes (second electrodes) arranged at a pitch of ca. 100 - 500  $\mu\text{m}$  in both cases of constituting a data signal side IC and a scanning signal side IC. Further, each driver IC may have ca. 200 - 500 output electrodes (first electrodes) arranged at a pitch of ca. 20 - 60  $\mu\text{m}$  when used as a data signal side IC and at a pitch of ca. 100 - 300  $\mu\text{m}$  when used as a scanning signal side IC. The circuit connection structure according to the present invention may be adopted for both data signal side ICs and scanning signal side IC but may preferably be used at least for data signal side ICs requiring output electrodes (first electrodes) arranged at a higher density in the embodiment of Figure 1.

[0047] Further to say, in a drive system using a liquid crystal showing bistability, such as a ferroelectric liquid crystal, an anti-ferroelectric liquid crystal or a BTN-mode liquid crystal driven in a binary mode, an areal gradational display mode according to a pixel division may be used, thus requiring an increased number of electrodes corresponding to the pixel division and arrangement of driver ICs and output electrodes at a higher density. In such cases, the circuit connection structure according to the present invention may preferably be used not only for data signal side ICs but also for scanning signal side ICs.

[0048] Figure 5 is a partial sectional view of a liquid crystal display apparatus including a drive circuit connection structure according to a second embodiment of the present invention, wherein copper foil patterns 17 and connection electrodes 19 on a circuit board 3 are connected with a solder 20. Other members denoted by identical numerals as in Figure 2 represent identical or like members as in Figure 2, and 23 represents an aperture formed in a polyimide film carrier 4 at the soldering portion.

[0049] Figure 6 is a partial sectional view of a liquid crystal display apparatus including a drive circuit connection structure according to a third embodiment of the present invention, wherein the connection structure is protected by a resinous sealing agent 21 and reinforced

by a reinforcing plate 22. In this instance, after applying the resinous sealing agent 21, the reinforcing plate may be bonded to the glass substrate 1a and the circuit board 3 from the back sides, so as to prevent the breakage of the electrical connection even when a stress is applied to the circuit board 3. It is particularly preferred to adopt the reinforcement structure with the reinforcing plate 22 in case where one side of electrodes (output electrodes in this embodiment) of the driver IC 5 are bonded to electrode terminals on the substrate 1b without using a flexible wiring member as in this embodiment.

[0050] Figure 7 is a sectional view a drive circuit connection structure according to a fourth embodiment of the present invention, wherein a driver IC 5 is connected to a flexible wiring member 4a with an anisotropic conductive adhesive 26. The connection structure may be incorporated in a liquid crystal display apparatus having a sectional structure as shown in Figure 8, wherein the projecting electrodes 13 of the driver IC 5 are thermally pressure-bonded to electrode terminals 12 on the glass substrate 1b via an anisotropic conductive adhesive 14, and conductors 17 on the flexible wiring member 4a are thermally pressure-bonded to connection electrodes 19 on a circuit board 3.

[0051] In Figure 8, the conductors (copper foil patterns) 17 are disposed on an upper surface of the flexible wiring member 4a, and correspondingly the circuit board 3 is disposed above the flexible wiring member 4a (on the side having the conductors 17).

[0052] Figure 9 is a partial sectional view of a liquid crystal display apparatus including a drive circuit connection structure according to a fifth embodiment of the present invention, wherein a reinforcing plate 30 is disposed along and bonded to the circuit board 3, the driver IC 5 and another substrate 1a in a structure similar to the one shown in Figure 8. The resultant structure is resistant to a stress applied to the circuit board 3, etc., thus being able to avoid a breakage of the electrical connection similarly as in the embodiment of Figure 6.

[0053] Figure 10 is a partial sectional view of a liquid crystal display apparatus including a drive circuit connection structure according to a sixth embodiment of the present invention, wherein electrode terminals 12 on the glass substrate 1b and the projecting electrodes 13 on the driver IC 5 are thermally pressure-bonded to each other via an anisotropic conductive adhesive 14 after positional alignment therebetween, input electrodes 29 of the driver IC 5 are electrically connected to connection electrodes on the circuit board 3 with conductive wires 28, and a reinforcing plate 30 is provided to fix the glass substrate 1a, the driver IC and the circuit board 3 by bonding similarly as in Figure 9.

[0054] Finally, an organization of a liquid crystal display apparatus including a liquid crystal display panel as described above together with a control system thereof will be briefly described with reference to a block diagram of such a liquid crystal display apparatus, for example, shown in Figure 11.

9

EP 0 795 772 B1

10

[0055] Referring to Figure 11, a liquid crystal display apparatus, such as a color display apparatus, may include a liquid crystal panel 1 as described above according to the present invention, to which are connected a scanning signal application circuit 402 and a data signal application circuit 403 which are sequentially connected to a scanning signal control circuit 406 and a data signal control circuit 407, a drive control circuit 404 and then to a graphic controller 405. From the graphic controller 405, video data and a scanning scheme signal are supplied to the scanning signal control circuit 406 and the data signal control circuit 407 via the drive control circuit 404.

[0056] The video data is converted into scanning line address data and display data by the scanning signal control circuit 406 and the data signal control circuit 407, and the scanning scheme signal is supplied as it is to the data signal application circuit 402 and the data signal application circuit 403.

[0057] The scanning signal application circuit 402 applies a scanning signal determined by the scanning scheme signal to the scanning electrodes in a sequence determined by the scanning line address data, and the data signal application circuit 403 applies data signals having waveforms determined by a combination of the display data determining white or black display states and the scanning scheme signal to the respective data electrodes. These data signals and scanning signals are supplied via flat cables 6 and 7 to circuit board 3 and 10, whereby a picture display may be performed on the liquid crystal panel 1 as shown in Figure 1.

[0058] In the above, the circuit connection structure according to the present invention has been described principally as one suitably used in a liquid crystal display apparatus but may also be suitably incorporated in other display apparatus inclusive of those including self-light emission-type flat display panels as represented by an EL-display panel and a plasma display panel.

[0059] As described above, according to the present invention, by connecting electrode terminals disposed on a peripheral side of a display panel to first electrodes on one side of a drive semiconductor device with, e.g., an anisotropic conductive adhesive, the electrode terminals and the drive semiconductor device may be connected without a flexible wiring member, thus ensuring a small connection pitch.

[0060] On the other hand, second electrodes on the other side of the drive semiconductor device may be connected to a flexible wiring member, and the flexible wiring member is connected to a circuit board on a supply side with a solder or an anisotropic conductive adhesive, the power and signal can be supplied to the driver semiconductor device at a low impedance. As a result, even if a display panel, such as a liquid crystal display panel, is enlarged in areal size and driven at a higher speed, drive waveforms can be transmitted to pixel electrodes of the display panel without transmission delay or deformation of drive waveforms. Further, in case

of supplying picture data for a display panel of a higher definition it is possible to obviate a mal-function during data transmission.

## Claims

1. A circuit connection structure comprising a first substrate (1b) having electrode terminals (12) formed thereon, a semiconductor device (5) having first electrodes (13) and second electrodes (15) with the first electrodes (13) directly connected to the electrode terminals (12) of the first substrate (1b), a flexible wiring member (4a, 28) comprising a plurality of conductors (17,28) each extending from a first end to a second end thereof with the first ends of the conductors connected to the second electrodes (15) of the semiconductor device, and a circuit board (3) disposed with a space from the first substrate and having thereon electrodes (19) connected to the second ends of the conductors (17, 28) of the flexible wiring member; **characterized in that** said semiconductor device (5) overhangs an edge of the first substrate (1b) such that the flexible wiring member (4a, 28) is free from physical contact with the first substrate (1b).
2. A connection structure according to claim 1, wherein the plurality of conductors (27) are formed in a pattern on a flexible carrier film so as to provide the flexible wiring member (4a).
3. A connection structure according to claim 2, wherein the second electrodes (15) of the semiconductor device (5) are connected to the first ends of the conductors (17) on the flexible wiring member (4a) by tape-automated bonding.
4. A connection structure according to claim 2, wherein the second electrodes (15) of the semiconductor device (5) are connected to the first ends of the conductors (17) of the flexible wiring member (4a) with an anisotropic conductive adhesive (26).
5. A connection structure according to any preceding claim 2 to 4, wherein the first electrodes (13) of said semiconductor device (5) and the electrode terminals (12) on the first substrate (1b) are connected to each other substantially solely with an anisotropic conductive adhesive (14).
6. A connection structure according to any preceding claim 2 to 5, wherein the second ends of the conductors (17) of the flexible wiring member (4a) and the electrodes (19) of the circuit board (3) are connected to each other with solder (20).
7. A connection structure according to any preceding

11

EP 0 795 772 B1

12

- claim 2 to 5, wherein the second ends of the conductors (17) of the flexible wiring member (4a) and the electrodes (19) of the circuit board (3) are connected to each other with an anisotropic conductive adhesive (18).
8. A connection structure according to any preceding claim 2 to 7, wherein a connecting part between the second electrodes (15) of the semiconductor device (5) and the first ends of the conductors (17) of the flexible wiring member (4a) is sealed with a resin (16).
9. A connection structure according to claim 1, wherein the plurality of conductors of the flexible wiring member comprise a plurality of individual conductor wires (28).
10. A connection structure according to any preceding claim 2 to 9, further including a reinforcing plate (22) fixedly supporting the first substrate (1b) and the circuit board (3).
11. A connection structure according to any preceding claim 2 to 10, wherein said semiconductor device (5) has the first and second electrodes (13,15) as output and input electrodes, respectively, thereof so as to receive input data from the circuit board (3) and supply output signals to the first substrate (1b), thereby to drive an electronic device (1) including the first substrate (1b).
12. A display apparatus comprising:
- a circuit connection structure according to any preceding claim 2 to 10; and
- a display panel (1) comprising said first substrate (1b) and having pixel electrodes extending to form said electrode terminals (12) on a peripheral edge of said first substrate (1b); wherein
- said semiconductor device (5) has, as said first electrodes (13), output electrodes for supplying drive waveforms to the pixel electrodes of said display panel (1); and
- said circuit board (3) is to supply electric power and control signals to said semiconductor device (5) via said flexible wiring member (4a; 28).
13. A display apparatus according to claim 12, which includes said circuit connection structure according to claim 10, wherein said reinforcing plate (22) is bonded to and supports said first substrate (1b) and the circuit board (3) from sides opposite to sides carrying the electrode terminals (12) of said first substrate (1b) and said electrodes (19) of the circuit board (3).
14. A display apparatus according to claim 12, which includes said circuit connection structure according to any preceding claim 2 to 8, wherein another substrate (1a) is disposed opposite to said first substrate (1b) of the display panel (1), and a reinforcing plate (22) is bonded to and supports said another substrate from its side not facing said first substrate (1b) and said circuit board (3) from its side opposite to the side carrying said electrodes (19).
15. A display apparatus according to any preceding claim 12 to 14, wherein said display panel (1) is a liquid crystal display panel.
16. A tape carrier package structure comprising a semiconductor device (5) having first electrodes (13) arranged at a pitch of 20 - 60  $\mu\text{m}$ , and a flexible wiring member (4a) comprising a flexible carrier film and a pattern of conductors (27) formed on the carrier film, each conductor on the carrier film extending from a first end to a second end, the first ends of the conductors being connected to second electrodes (15) of the semiconductor device (5), said tape carrier package structure being adapted to electrically connect a first substrate (1b), having electrode terminals formed thereon, and a circuit board (3) disposed with a space from the first substrate (1b) in such a manner that the semiconductor device (5) overhangs an edge of the first substrate (1b) when the first electrodes of the semiconductor device (5) are directly connected to the electrodes of the first substrate, and the flexible wiring member (4a) is free from physical contact with the first substrate (1b) when the circuit board (3) is connected with the second ends of the conductors of the flexible wiring member (4a).
17. A structure according to claim 16, wherein said semiconductor device (5) has the first and second electrodes (13,15) as output and input electrodes, respectively, thereof.
18. A structure according to either of claims 16 or 17, wherein the second electrodes (15) of the semiconductor device (5) are connected to the first ends of the conductors (27) of the flexible wiring member (4a) by tape-automated bonding.

## 50 Patentansprüche

### 1. Schaltungsverbindungsaufbau mit:

einem ersten Substrat (1b) mit darauf ausgebildeten Elektrodenanschlüssen (12),  
einer Halbleitervorrichtung (5) mit ersten Elektroden (13) und zweiten Elektroden (15), wobei die ersten Elektroden (13) unmittelbar mit den



13

EP 0 795 772 B1

14

Elektrodenanschlüssen (12) des ersten Substrates (1b) verbunden sind, einem flexiblen Leiterbahnelement (4a, 28) mit einer Vielzahl von Leitern (17, 28), die sich jeweils von einem ersten Ende davon zu einem zweiten Ende davon erstrecken, wobei die ersten Enden der Leiter mit den zweiten Elektroden (15) der Halbleitervorrichtung verbunden sind, und einer Schaltungsplatine (3), die mit einem Abstand von dem ersten Substrat angeordnet ist, und auf der mit den zweiten Enden der Leiter (17, 28) des flexiblen Leiterbahnelementes verbundene Elektroden (19) bereitgestellt sind;

**dadurch gekennzeichnet, dass**

die Halbleitervorrichtung (5) über eine Kante des ersten Substrates (1b) derart hervorsteht, dass das flexible Leiterbahnelement (4a, 28) frei von einem physikalischen Kontakt mit dem ersten Substrat (1b) ist.

2. Verbindungsstruktur nach Anspruch 1, wobei die Vielzahl von Leitern (27) in einem Muster auf einer flexiblen Trägerlage ausgebildet sind, so dass das flexible Leiterbahnelement (4a) bereitgestellt wird.
3. Verbindungsstruktur nach Anspruch 2, wobei die zweiten Elektroden (15) der Halbleitervorrichtung (5) mit den ersten Enden der Leiter (17) auf dem flexiblen Leiterbahnelement (4a) durch einen bandautomatisierten Verbindungsvorgang verbunden sind.
4. Verbindungsstruktur nach Anspruch 2, wobei die zweiten Elektroden (15) der Halbleitervorrichtung (5) mit den ersten Enden der Leiter (17) des flexiblen Leiterbahnelementes (4a) mit einem anisotrop leitenden Haftmittel (26) verbunden sind.
5. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 4, wobei die ersten Elektroden (13) der Halbleitervorrichtung (5) und die Elektrodenanschlüsse (12) auf dem ersten Substrat (1b) miteinander im wesentlichen alleine mit einem anisotrop leitenden Haftmittel (14) verbunden sind.
6. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 5, wobei die zweiten Enden der Leiter (17) des flexiblen Leiterbahnelementes (4a) und die Elektroden (19) der Schaltungsplatine (3) miteinander mit einem Lötmittel (20) verbunden sind.
7. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 5, wobei die zweiten Enden der Leiter (17) des flexiblen Leiterbahnelementes (4a) und die Elektroden (19) der Schaltungsplatine (3)

miteinander mit einem anisotrop leitenden Haftmittel (18) verbunden sind.

8. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 7, wobei ein Verbindungsteil zwischen den zweiten Elektroden (15) der Halbleitervorrichtung (5) und den ersten Enden der Leiter (17) des flexiblen Leiterbahnelementes (4a) mit einem Harz (16) versiegelt ist.
9. Verbindungsstruktur nach Anspruch 1, wobei die Vielzahl von Leitern des flexiblen Leiterbahnelementes eine Vielzahl von individuellen Leiterdrähten (28) aufweisen.
10. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 9, zudem mit einer Verstärkungsplatte (22), die das erste Substrat (1b) und die Schaltungsplatine (3) fest unterstützt.
11. Verbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 10, wobei die Halbleitervorrichtung (5) die ersten und zweiten Elektroden (13, 15) als ihre Ausgangs- bzw. Eingangselektroden umfasst, so dass Eingangsdaten von der Schaltungsplatine (3) empfangen und Ausgangssignale dem ersten Substrat (1b) zugeführt werden, wodurch eine das erste Substrat (1b) beinhaltende elektronische Vorrichtung (1) angesteuert wird.
12. Anzeigegerät mit:
 

einer Schaltungsverbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 10; und einem Anzeigefeld (1) mit dem ersten Substrat (1b) und mit sich zur Ausbildung der Elektrodenanschlüsse (12) auf einer Randkante des ersten Substrates (1b) erstreckenden Bildelementelektroden; wobei

die Halbleitervorrichtung (5) als erste Elektroden (13) Ausgangselektroden zum Zuführen von Ansteuerungsspannungen an die Bildelementelektroden des Anzeigefeldes (1) aufweist; und

die Schaltungsplatine (3) der Halbleitervorrichtung (5) über das flexible Leiterbahnelement (4a; 28) elektrische Energie und Steuersignale zuführt.
13. Anzeigegerät nach Anspruch 12, mit der Schaltungsverbindungsstruktur nach Anspruch 10, wobei die Verstärkungsplatte (22) mit dem ersten Substrat (1b) und der Schaltungsplatine (3) verbunden ist und diese von der Seite unterstützt, die der die Elektrodenanschlüsse (12) des ersten Substrates (1b) und die Elektroden (19) der Schaltungsplatine (3) tragenden Seite gegenüberliegt.

15

EP 0 795 772 B1

16

14. Anzeigegerät nach Anspruch 12, mit der Schaltungsverbindungsstruktur nach einem der vorstehenden Ansprüche 2 bis 8, wobei ein weiteres Substrat (1a) gegenüber dem ersten Substrat (1b) des Anzeigefeldes (1) angeordnet ist, und eine Verstärkungsplatte (22) das weitere Substrat von dessen dem ersten Substrat (1b) nicht zugewandten Seite und die Schaltungsplatine (3) von deren der die Elektroden (19) tragenden Seite gegenüberliegenden Seite unterstützt und mit diesen verbunden ist.

15. Anzeigegerät nach einem der vorstehenden Ansprüche 12 bis 14, wobei das Anzeigefeld (1) ein Flüssigkristallanzeigefeld ist.

16. Tape Carrier Package-Struktur mit einer Halbleitervorrichtung (5) mit ersten Elektroden (13), die mit einem Maß von 20-60 µm angeordnet sind, und

einem flexiblen Leiterbahnelement (4a) mit einer flexiblen Trägerlage und einem auf der Trägerlage ausgebildeten Muster von Leitern (27), wobei sich jeder Leiter auf der Trägerlage von einem ersten Ende zu einem zweiten Ende erstreckt,

die ersten Enden der Leiter mit zweiten Elektroden (15) der Halbleitervorrichtung (5) verbunden sind,

die Tape Carrier Package-Struktur zur elektrischen Verbindung eines ersten Substrats (1b) angepasst ist, Elektrodenanschlüssen darauf ausgebildeten sind, und eine Schaltungsplatine (3) derart mit einem Abstand von dem ersten Substrat (1b) angeordnet ist, dass die Halbleitervorrichtung (5) über eine Kante des ersten Substrats (1b) hervorsteht, wenn die ersten Elektroden der Halbleitervorrichtung (5) unmittelbar mit den Elektroden des ersten Substrats verbunden sind, und

das flexible Leiterbahnelement (4a) frei von einem physikalischen Kontakt mit dem ersten Substrat (1b) ist, wenn die Schaltungsplatine (3) mit den zweiten Enden der Leiter des flexiblen Leiterbahnelementes (4a) verbunden ist.

17. Struktur gemäß Anspruch 16, wobei die Halbleitervorrichtung (5) die ersten und zweiten Elektroden (13, 15) als ihre Ausgangs- bzw. Eingangselektroden aufweist.

18. Struktur nach einem der Ansprüche 16 oder 17, wobei die zweiten Elektroden (15) der Halbleitervorrichtung (5) mit den ersten Enden der Leiter (27) des flexiblen Leiterbahnelementes (4a) durch einen bandautomatisierten Verbindungsvorgang verbunden sind.

## Revendications

1. Structure de connexion de circuit comportant un premier substrat (1b) ayant des bornes d'électrodes (12) formées sur lui, un dispositif semiconducteur (5) ayant des premières électrodes (13) et des secondes électrodes (15), les premières électrodes (13) étant connectées directement aux bornes d'électrodes (12) du premier substrat (1b), un élément de câblage souple (4a, 28) comportant plusieurs conducteurs (17, 28) s'étendant chacun d'une première extrémité à une seconde extrémité, les premières extrémités des conducteurs étant connectées aux secondes électrodes (15) du dispositif semiconducteur, et une plaquette (3) à circuit disposée de façon à former un espace par rapport au premier substrat et portant des électrodes (19) connectées aux secondes extrémités des conducteurs (17, 28) de l'élément de câblage souple ; caractérisée en ce que

ledit dispositif semiconducteur (5) déborde en surplomb d'un bord du premier substrat (1b) de manière que l'élément de câblage souple (4a, 28) n'ait aucun contact physique avec le premier substrat (1b).

2. Structure de connexion selon la revendication 1, dans laquelle la pluralité de conducteurs (27) est formée suivant un motif sur un film souple de support de façon à constituer l'élément de câblage souple (4a).

3. Structure de connexion selon la revendication 2, dans laquelle les secondes électrodes (15) du dispositif semiconducteur (5) sont connectées aux premières extrémités des conducteurs (17) sur l'élément de câblage souple (4a) par un soudage automatisé sur bande.

4. Structure de connexion selon la revendication 2, dans laquelle les secondes électrodes (15) du dispositif semiconducteur (5) sont connectées aux premières extrémités des conducteurs (17) de l'élément de câblage souple (4a) à l'aide d'un adhésif conducteur anisotrope (26).

5. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 4, dans laquelle les premières électrodes (13) dudit dispositif semiconducteur (5) et les bornes d'électrodes (12) sur le premier substrat (1b) sont connectées entre elles sensiblement uniquement à l'aide d'un adhésif conducteur anisotrope (14).

6. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 5, dans laquelle les secondes extrémités des conducteurs (17) de l'élément de câblage souple (4a) et les électrodes (19)

17

EP 0 795 772 B1

18

de la plaquette de circuit (3) sont connectées entre elles au moyen de soudure (20).

7. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 5, dans laquelle les secondes extrémités des conducteurs (17) de l'élément de câblage souple (4a) et les électrodes (19) de la plaquette de circuit (3) sont connectées entre elles au moyen d'un adhésif conducteur anisotrope (18). 5
8. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 7, dans laquelle une partie de connexion entre les secondes électrodes (15) du dispositif semiconducteur (5) et les premières extrémités des conducteurs (17) de l'élément de câblage souple (4a) est scellée à l'aide d'une résine (16). 10
9. Structure de connexion selon la revendication 1, dans laquelle la pluralité de conducteurs de l'élément de câblage souple comprend une pluralité de fils conducteurs individuels (28). 20
10. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 9, comprenant en outre une plaque de renfort (22) supportant fixement le premier substrat (1b) et la plaquette à circuit (3). 25
11. Structure de connexion selon l'une quelconque des revendications précédentes 2 à 10, dans laquelle ledit dispositif semiconducteur (5) comporte les première et seconde électrodes (13, 15) en tant qu'électrodes de sortie et d'entrée respectivement, de celui-ci afin de recevoir des données d'entrée provenant de la plaquette à circuit (3) et de fournir des signaux de sortie au premier substrat (1b), attaquant ainsi un dispositif électronique (1) comprenant le premier substrat (1b). 35
12. Appareil d'affichage comportant : 40
  - une structure de connexion de circuit selon l'une quelconque des revendications précédentes 2 à 10 ; et 45
  - un panneau d'affichage (1) comportant ledit premier substrat (1b) et ayant des électrodes de pixels s'étendant de façon à former lesdites bornes d'électrodes (12) sur un bord périphérique dudit premier substrat (1b) ; dans lequel 50

ledit dispositif semiconducteur (5) comporte, en tant que lesdites premières électrodes (13) des électrodes de sortie destinées à fournir des formes d'onde d'impact aux électrodes de pixels dudit panneau d'affichage (1) ; et 55

ladite plaquette à circuit (3) est destinée à

fournir de l'énergie électrique et des signaux de commande audit dispositif semiconducteur (5) par l'intermédiaire dudit élément de câblage souple (4a ; 28).

13. Appareil d'affichage selon la revendication 12, qui comprend ladite structure de connexion de circuit selon la revendication 10, dans lequel ladite plaque de renfort (22) est liée audit premier substrat (1b) et à la plaquette à circuit (3) et les supporte à partir de côtés opposés à des côtés portant les bornes d'électrodes (12) dudit premier substrat (1b) et lesdites électrodes (19) de la plaquette à circuit (3). 10
14. Appareil d'affichage selon la revendication 12, qui comprend ladite structure de connexion de circuit selon l'une quelconque des revendications précédentes 2 à 8, dans lequel un autre substrat (1a) est disposé de façon à être opposé audit premier substrat (1b) du panneau d'affichage (1), et une plaque de renfort (22) est liée audit autre substrat et le supporte à partir de son côté qui ne fait pas face au dit premier substrat (1b), et est liée à ladite plaquette à circuit (3) et la supporte à partir de son côté opposé au côté portant lesdites électrodes (19). 15
15. Appareil d'affichage selon l'une quelconque des revendications précédentes 12 à 14, dans lequel ledit panneau d'affichage (1) est un panneau d'affichage à cristaux liquides. 20
16. Structure de boîtier de support de bande comportant un dispositif semiconducteur (5) ayant des premières électrodes (13) agencées à un pas de 20 à 60  $\mu\text{m}$ , et un élément de câblage souple (4a) comportant un film de support souple et un motif de conducteurs (27) formé sur le film de support, chaque conducteur de film de support s'étendant depuis une première extrémité jusqu'à une seconde extrémité, les premières extrémités des conducteurs étant connectées aux secondes électrodes (15) du dispositif semiconducteur (5), ladite structure de boîtier de support de bande étant conçue pour connecter électriquement un premier substrat (1b), sur lequel des bornes d'électrodes sont formées, et une plaquette à circuit (3) disposée en formant un espace par rapport au premier substrat (1b) d'une manière telle que le dispositif semiconducteur (5) s'étend en surplomb depuis un bord du premier substrat (1b) lorsque les premières électrodes du dispositif semiconducteur (5) sont connectées directement aux électrodes du premier substrat, et l'élément de câblage souple (4a) est exempt de tout contact physique avec le premier substrat (1b) de sorte que la plaquette à circuit (3) est connectée aux secondes extrémités des conducteurs de l'élément de câblage souple (4a). 35

19

EP 0 795 772 B1

20

17. Structure selon la revendication 16, dans lequel le-  
dit dispositif semiconducteur (5) comporte les pre-  
mières et secondes électrodes (13, 15) constituant  
les électrodes de sortie et d'entrée, respectivement,  
de ce dispositif.

5

18. Structure selon une des revendications 16 ou 17,  
dans laquelle les secondes électrodes (15) du dis-  
positif semiconducteur (5) sont connectées aux  
premières extrémités des conducteurs (27) de l'élé-  
ment de câblage souple (4a) par soudage automa-  
tisé sur bande.

10

15

20

25

30

35

40

45

50

55

EP 0 795 772 B1

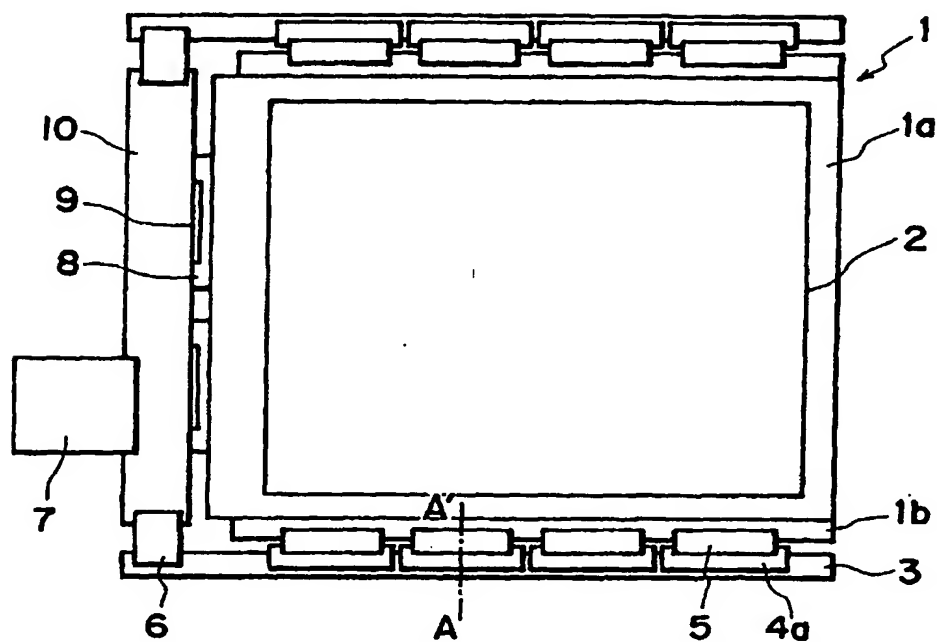


FIG. 1

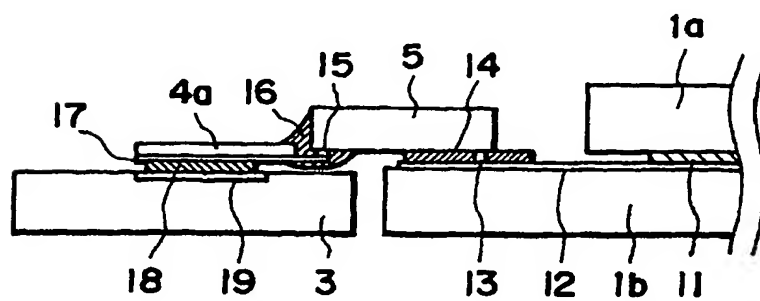


FIG. 2

EP 0 795 772 B1

FIG. 3A

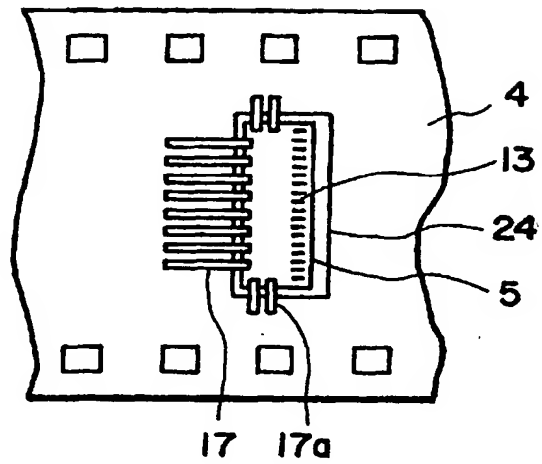


FIG. 3B

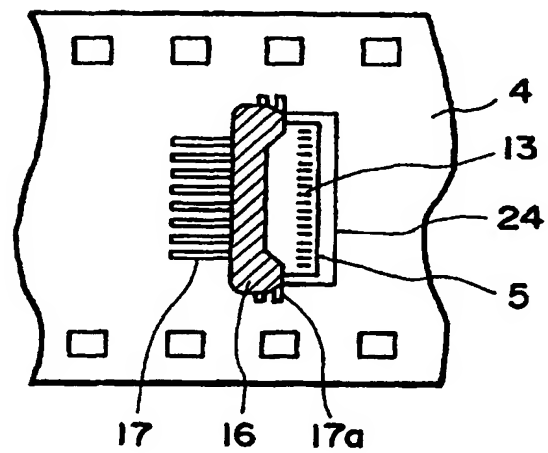
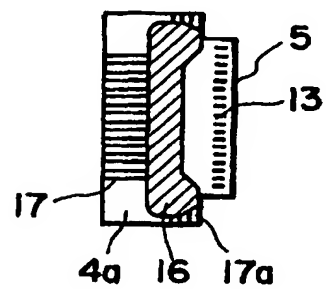
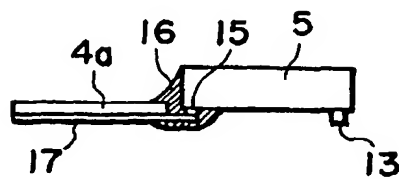
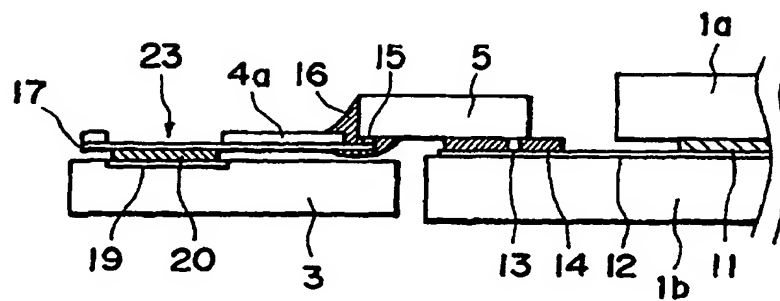
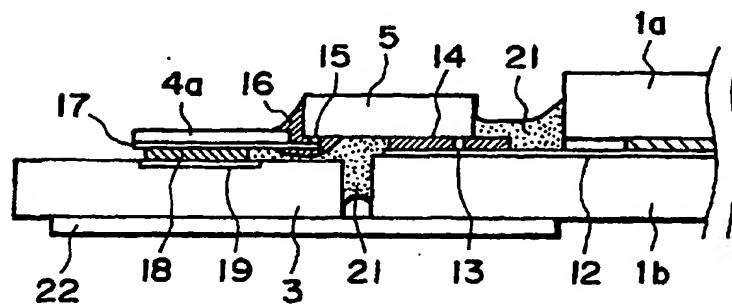
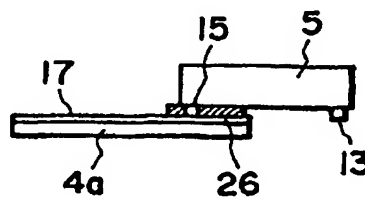


FIG. 3C



EP 0 795 772 B1

**FIG. 4****FIG. 5****FIG. 6****FIG. 7**

EP 0 795 772 B1

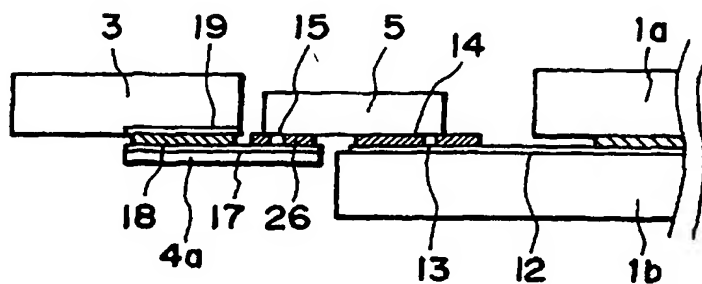


FIG. 8

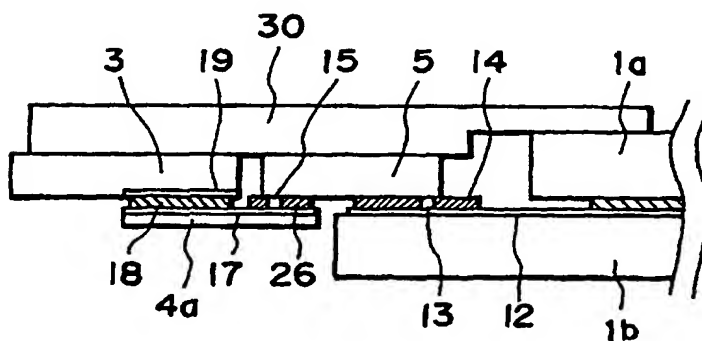


FIG. 9

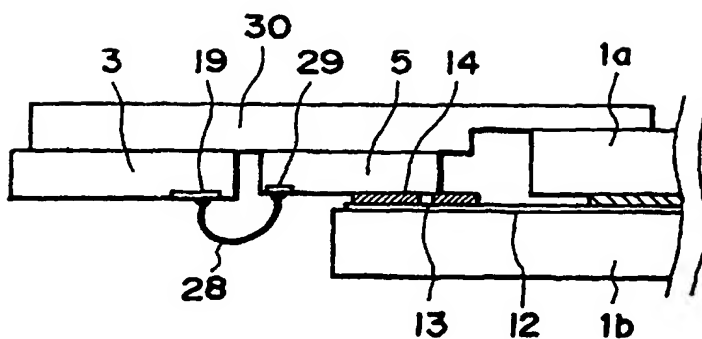
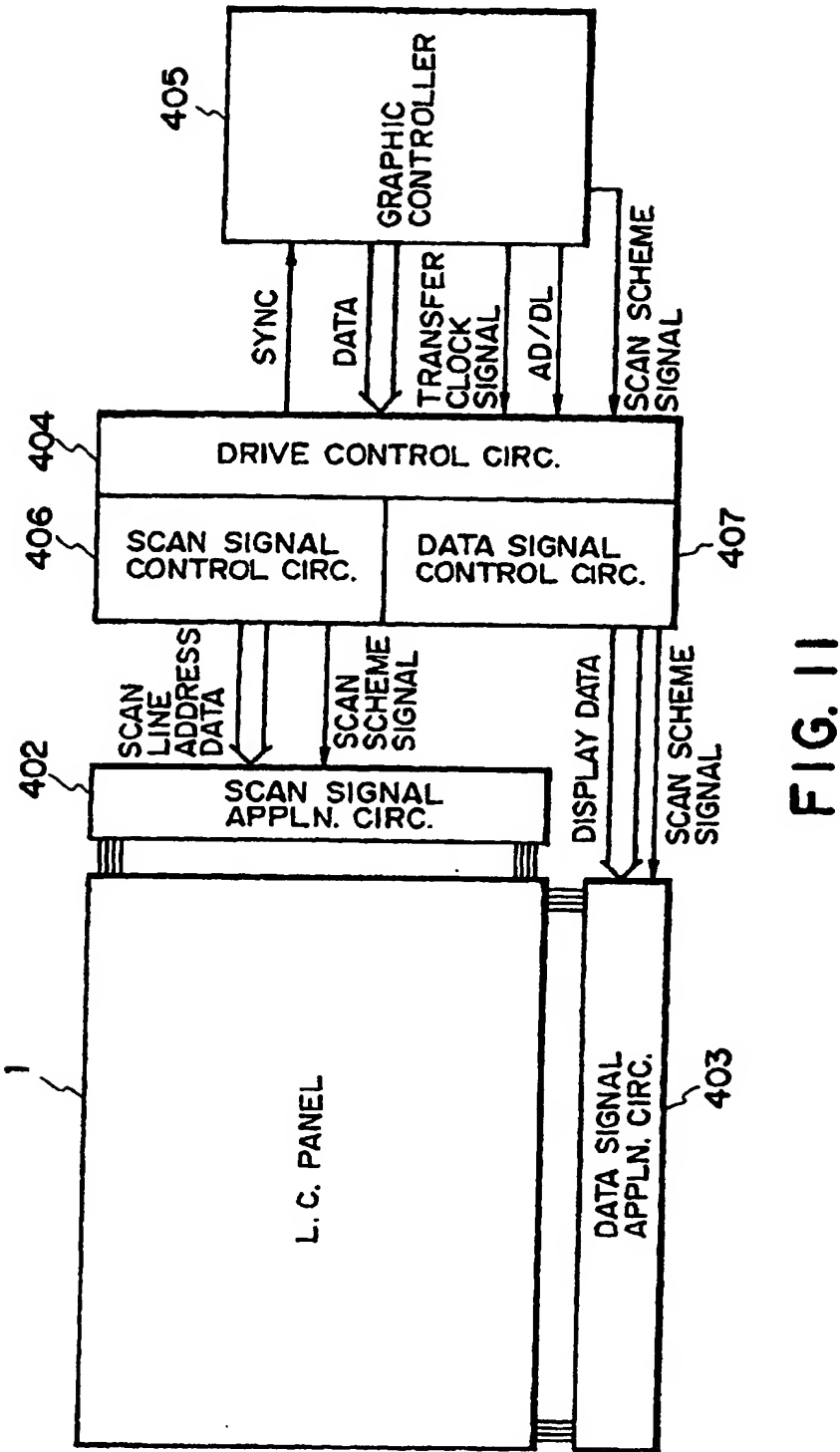


FIG. 10



EP 0 795 772 B1



EP 0 795 772 B1

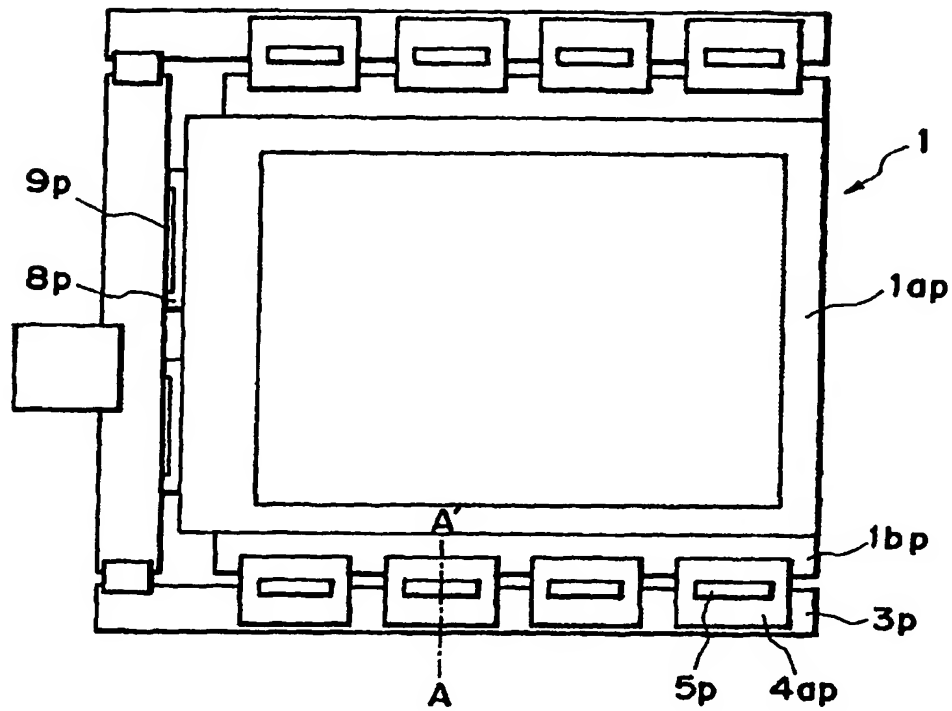


FIG. 12

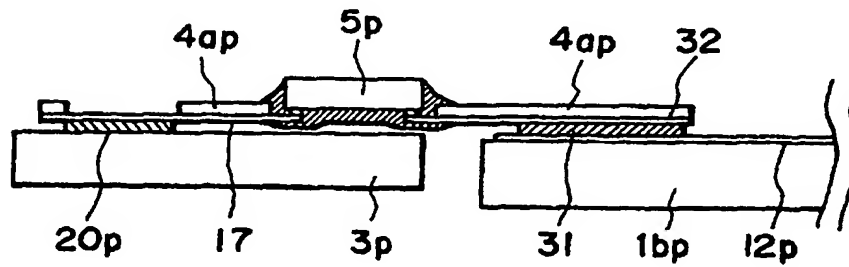
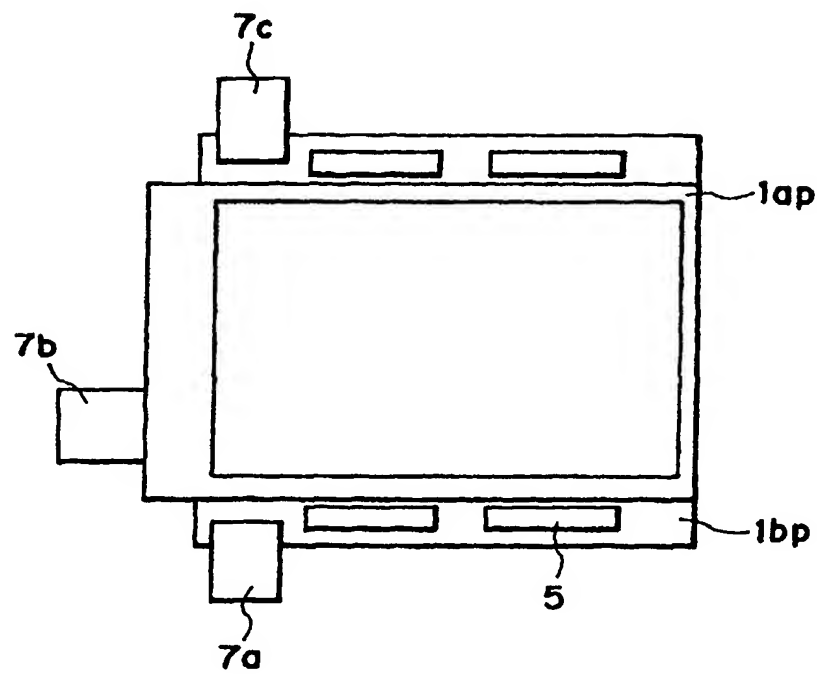


FIG. 13

EP 0 795 772 B1

**FIG. 14**